

LTE handover Procedure

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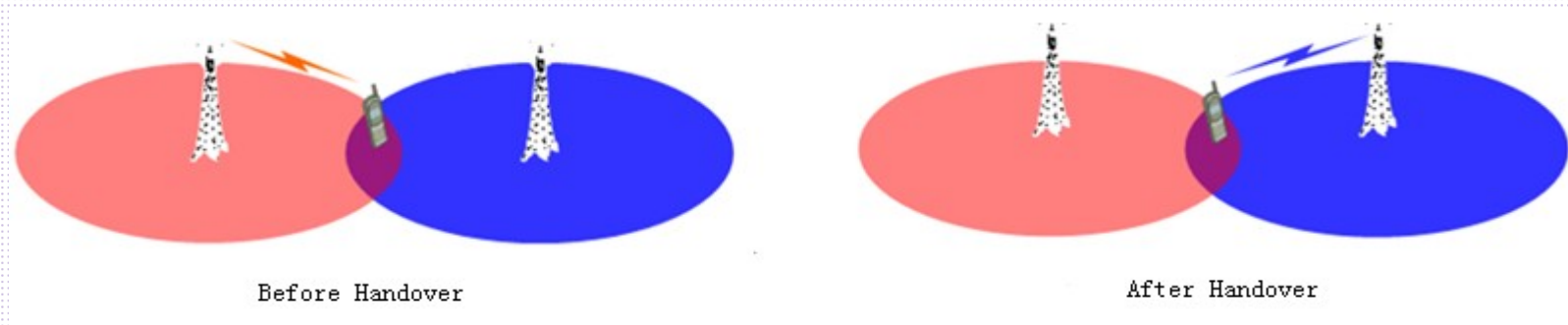
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Handover Overview

- **What Is Handover**

- Coverage-based handovers are introduced to ensure UE service continuity due to UE location changes and limited coverage of each cell in a wireless mobile environment.
- Handover means that a UE in connected mode moves between different cells to update the context of the UE.
- The eNodeB delivers related configuration information through control messages. The UE completes handover measurement and completes handovers under the control of the eNodeB, ensuring uninterrupted communication services. The following figure shows the UE connections before and after the handover.



Handover Type

➤ Intra-RAT

Frequency relationship □

- Intra-frequency handover
- Inter-frequency handover

Signaling Bearer Mode □

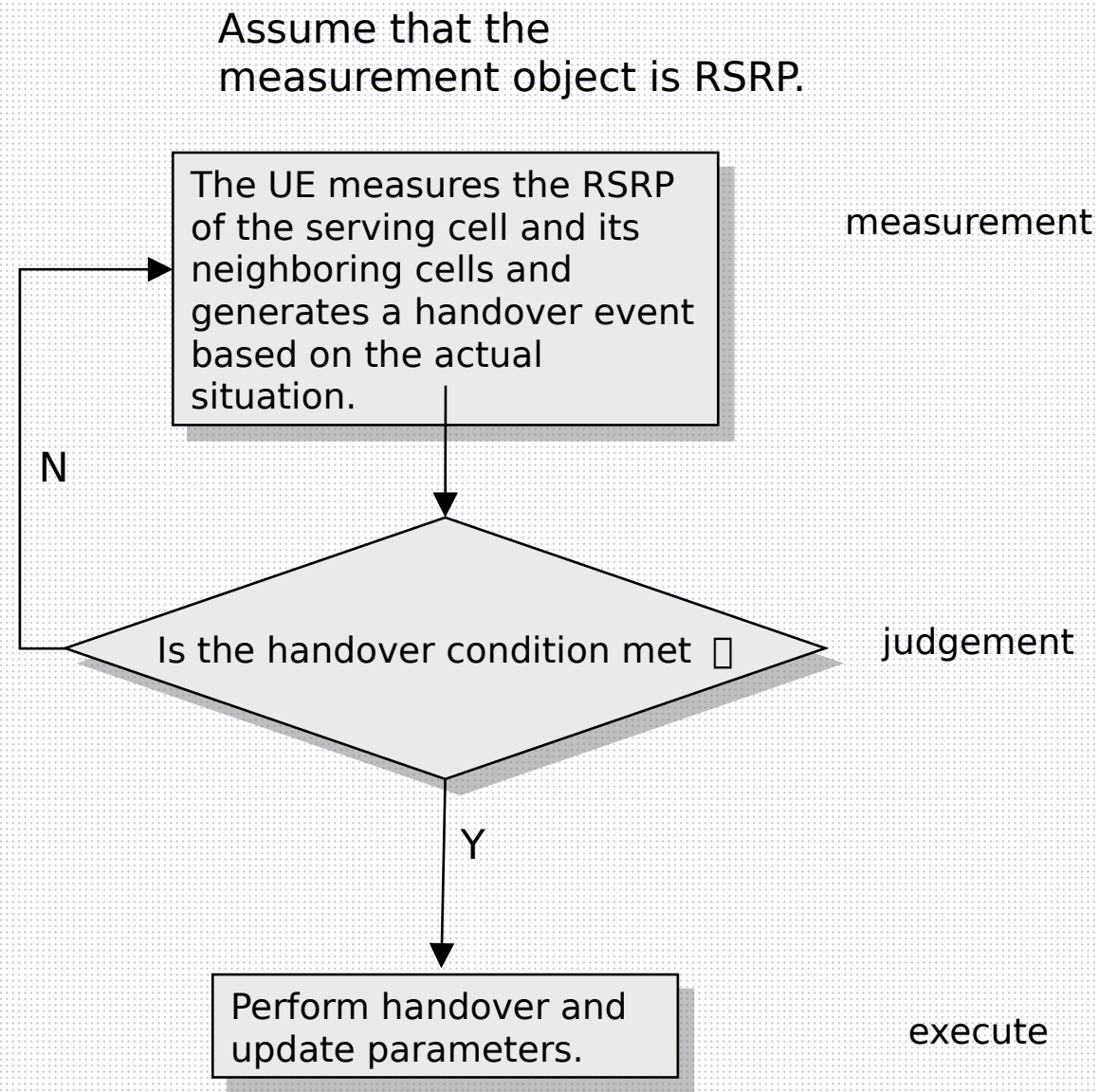
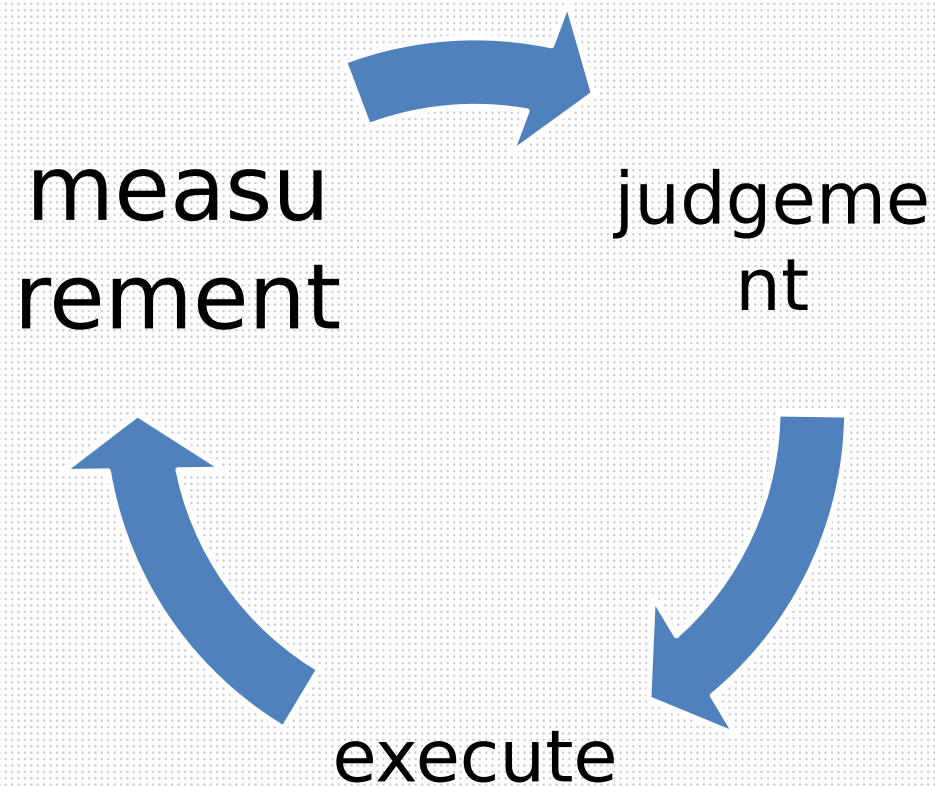
- Intra-eNodeB handover
- Intra-MME X2-based Handover (with X2 Interface)
- Intra-MME S1-based Handover (No X2 Interface)
- An inter-MME S1 interface handover is performed, and data is forwarded over the X2 interface (with the X2 interface).
- Inter-MME S1 interface handover, data is forwarded over the S1 interface (X2 interface is not available).

Triggering Reason □

- Coverage-based
- Load-based
- Frequency priority-based
- Service-based
- Based on uplink quality
- Distance-based

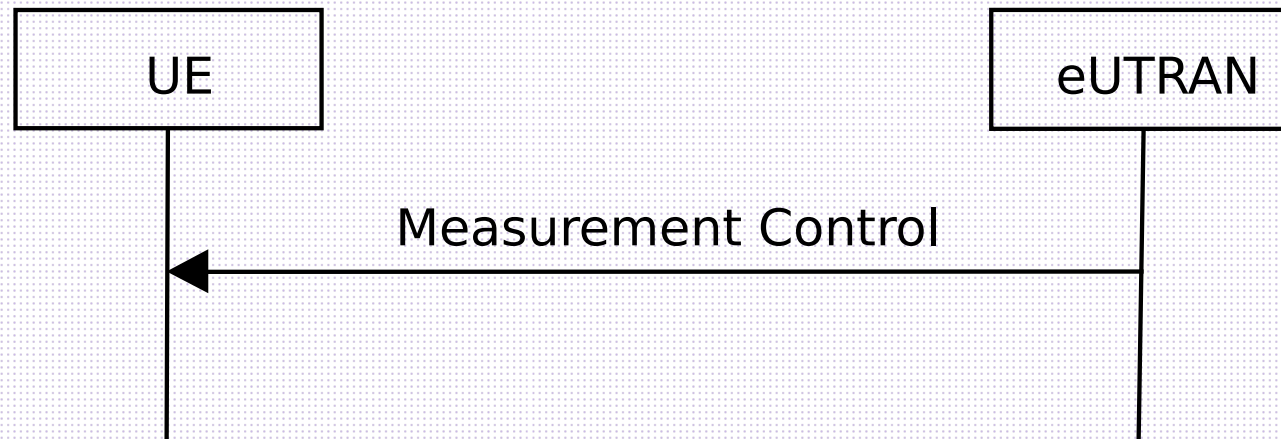
➤ Inter-RAT

handover trilogy



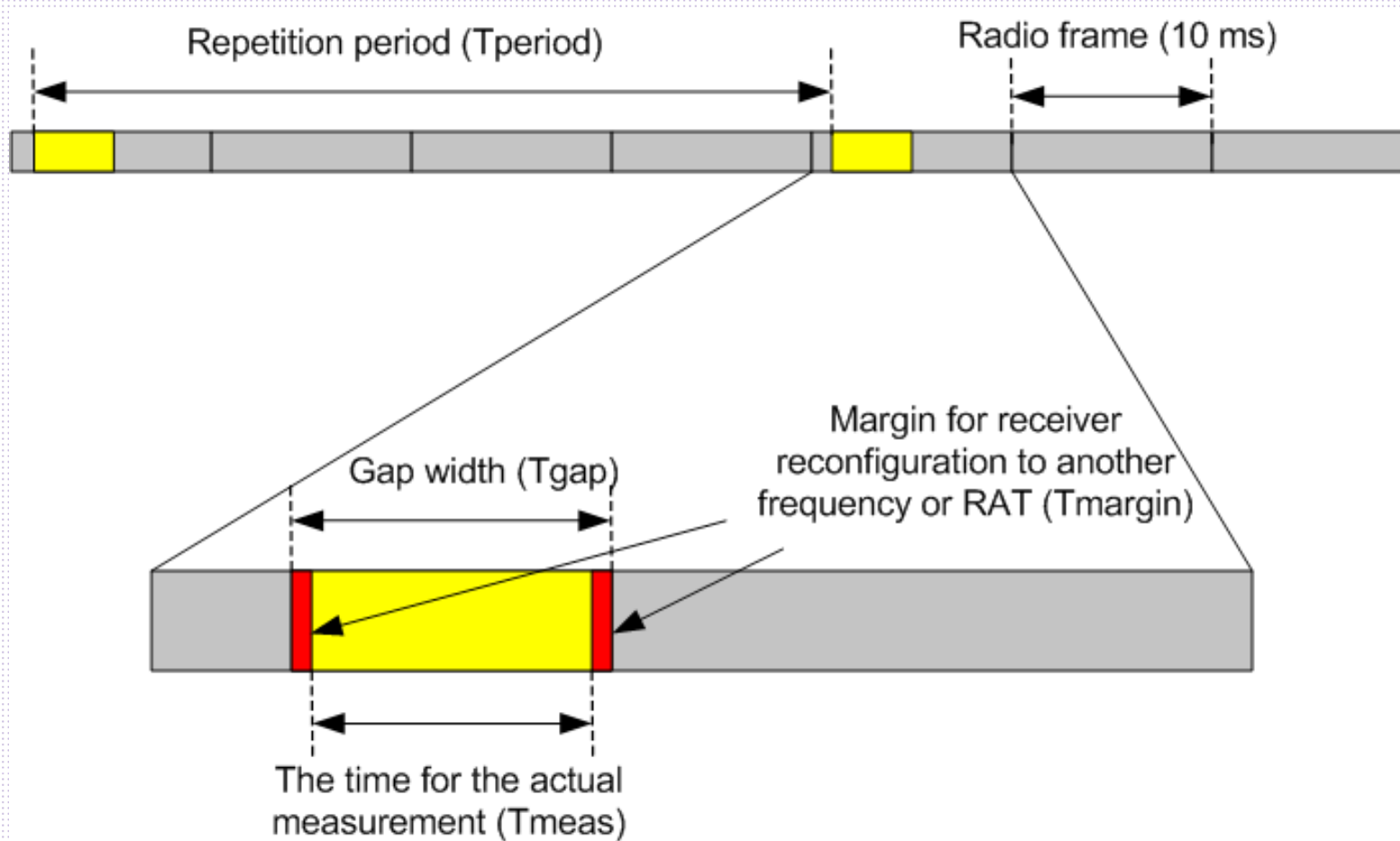
Measurement configuration

- Notifies the UE of the objects to be measured, neighboring cell list, reporting mode, and event parameters.
- When the measurement condition changes, the eNodeB notifies the UE of the new measurement condition.

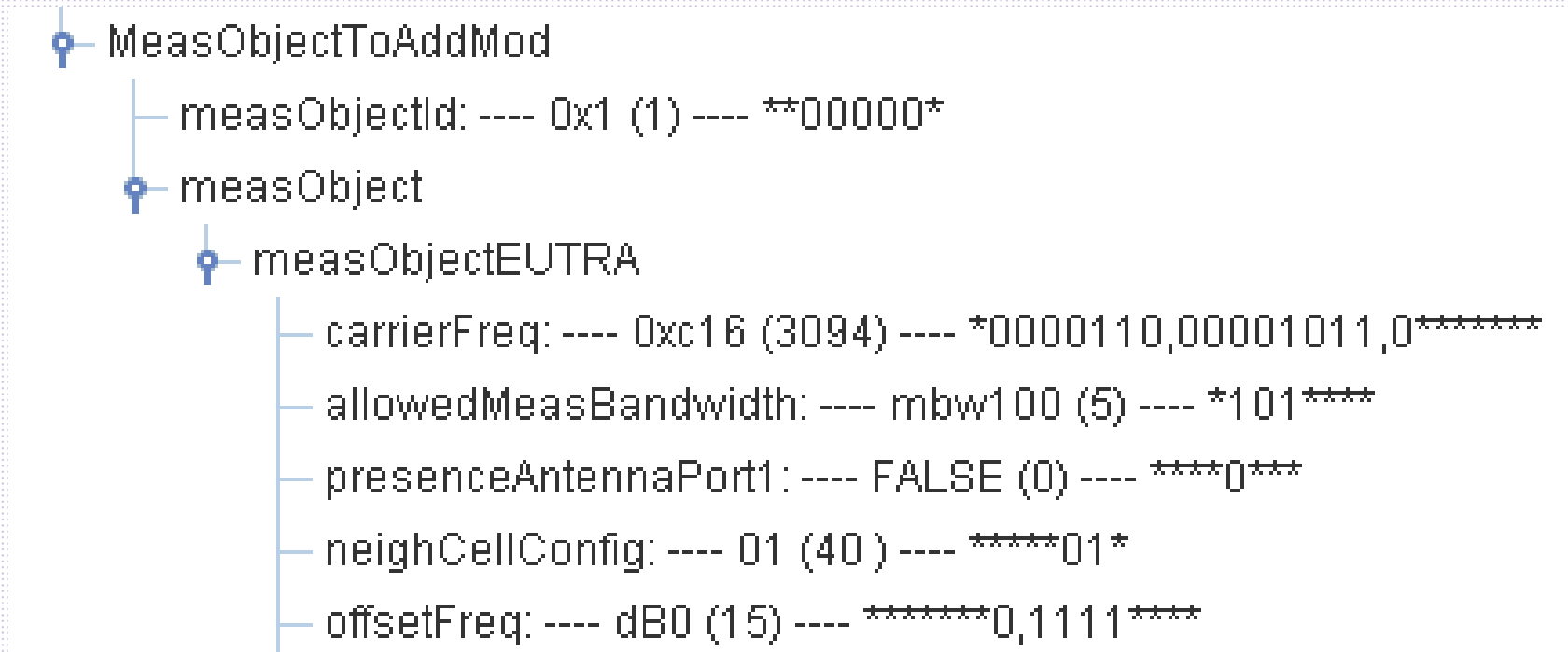


Measurement Control, normal case

Measurement Gap



Signaling Tracing Example - Measurement Object



- The eNodeB can create one or more measurement IDs based on measurement object and report configurations. The IDs correspond to the measurement object IDs and report IDs. In addition, the measurement ID is also reported when the UE sends a measurement report. This helps the eNodeB distinguish different measurement reports.

Measurement event

Event Type	Event Significance
A1	(Serving becomes better than threshold)
A2	(Serving becomes worse than threshold)
A3	(Neighbour becomes offset better than serving)
A4	(Neighbour becomes better than threshold)
A5	(Serving becomes worse than threshold1 and neighbour becomes better than threshold2)
B1	(Inter RAT neighbour becomes better than threshold)
B2	(Serving becomes worse than threshold1 and inter RAT neighbour becomes better than threshold2)

	A1	A2	A3	A4	A5	B1	B2
IntraFrequency			HO decision				
InterFrequency	stop measure	start measure		HO decision			
InterRAT	stop measure	start measure				HO decision	

Parameter Configuration (Intra-Frequency Handover)

Handover-related parameters are used to control the difficulty of handovers,

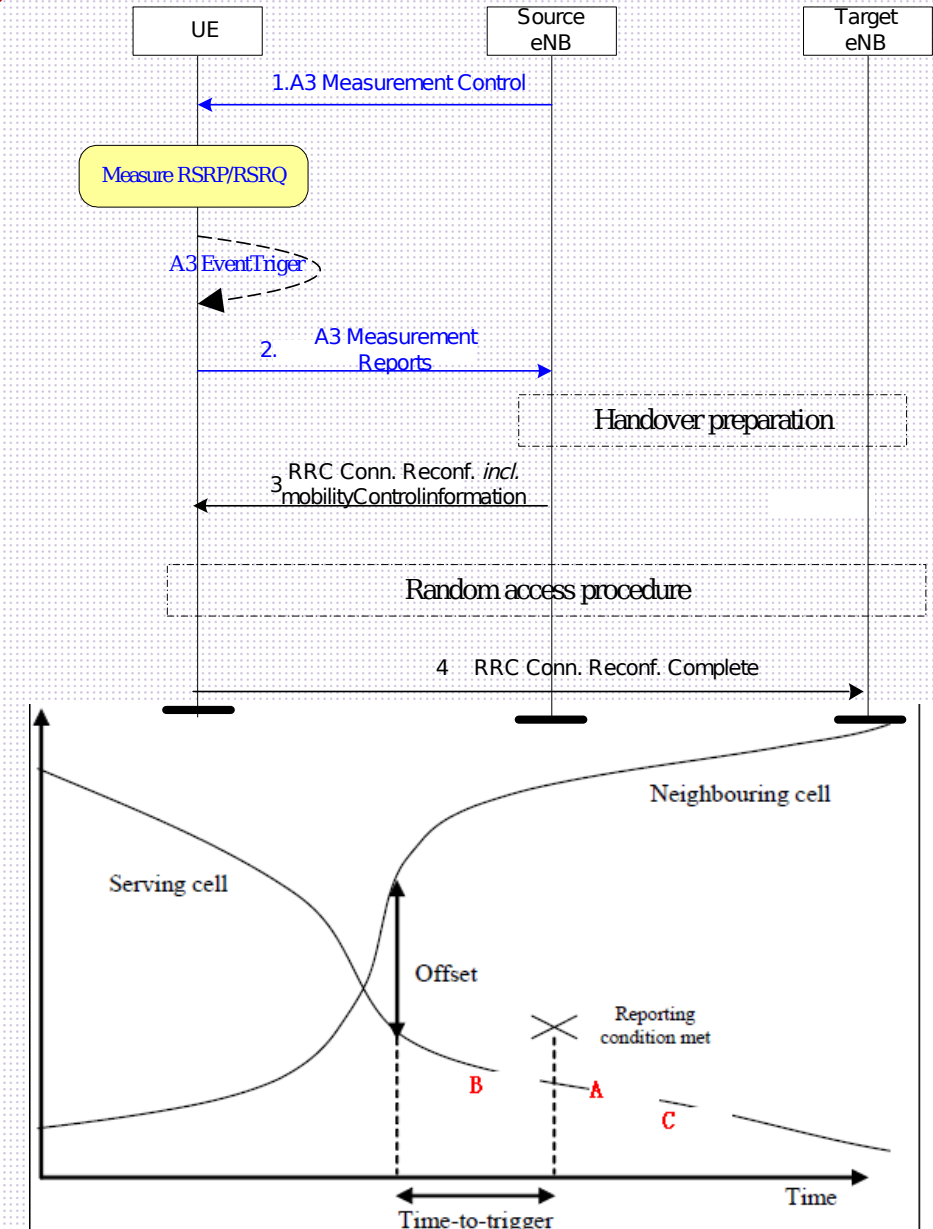
Time for reporting measurement reports

Intra-Frequency Handover Triggering Procedure

(Event A3)

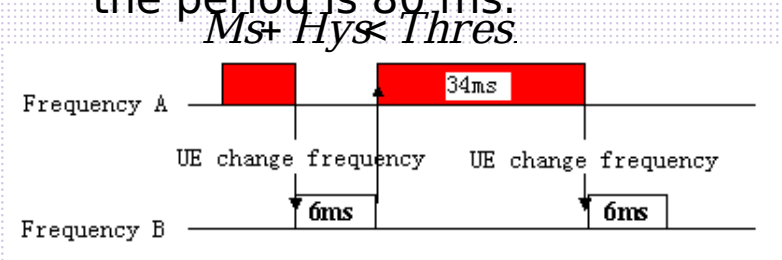
$M_n + O_{fn} + O_{cn} - Hys > M_s + O_{fs} + O_{cs} + Off$

- Measurement quantity RSRP/RSRQ of neighboring M_n cells
- Offset of the O_{fn} frequency
- O_{cn} neighboring cell offset, which is configured based on neighbor relationships.
- RSRP/RSRQ of the M_s serving cell
- O_{fs} serving frequency offset
- O_{cs} Serving Cell Offset
- Hys hysteresis coefficient, which is closely related to service characteristics and moving speed,
- Reduce the probability of ping-pong handovers.
- Off a3-Offset
- The unit of M_n and M_s is dBm or dB. Other values are dB.



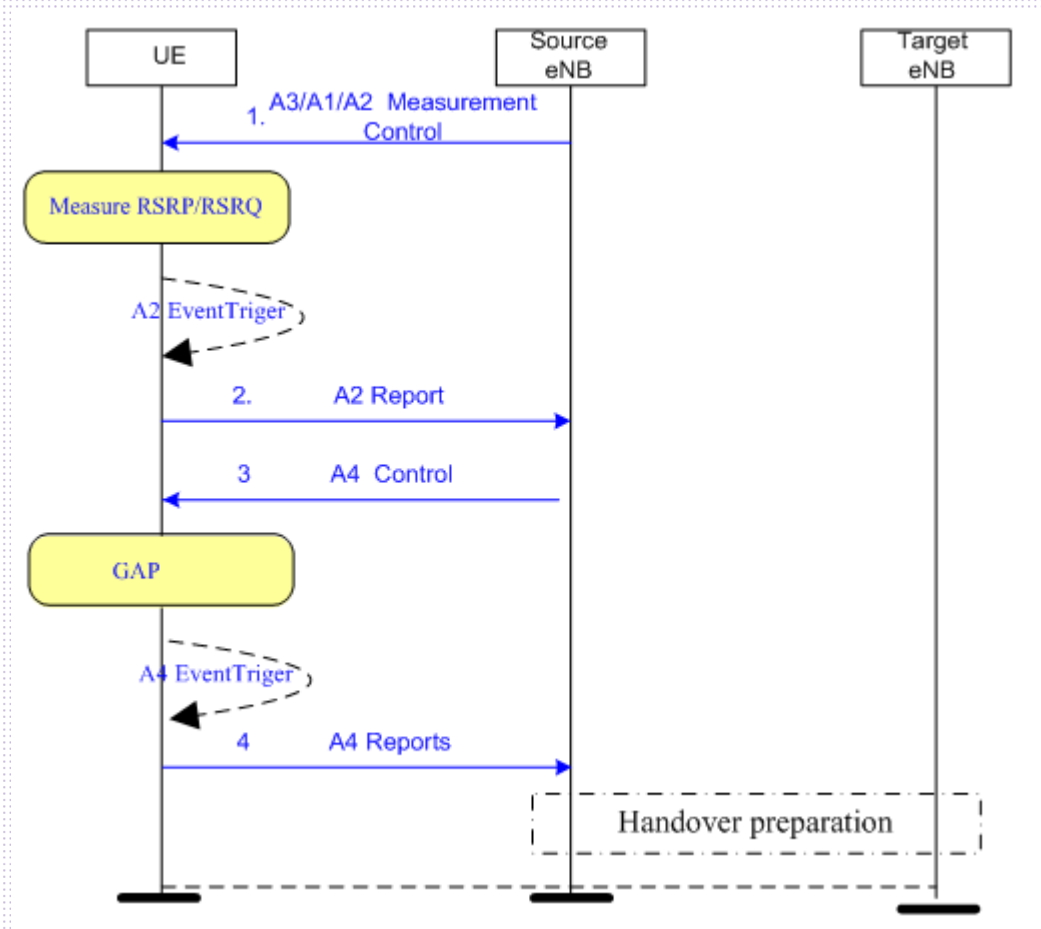
Parameter Configuration (Inter-Frequency Handover)

- Inter-Frequency Handover Triggering Process
- Event A2-triggered gap-assisted measurement
 - Two GAP modes
 - The period is 40 ms (default), and the period is 80 ms.



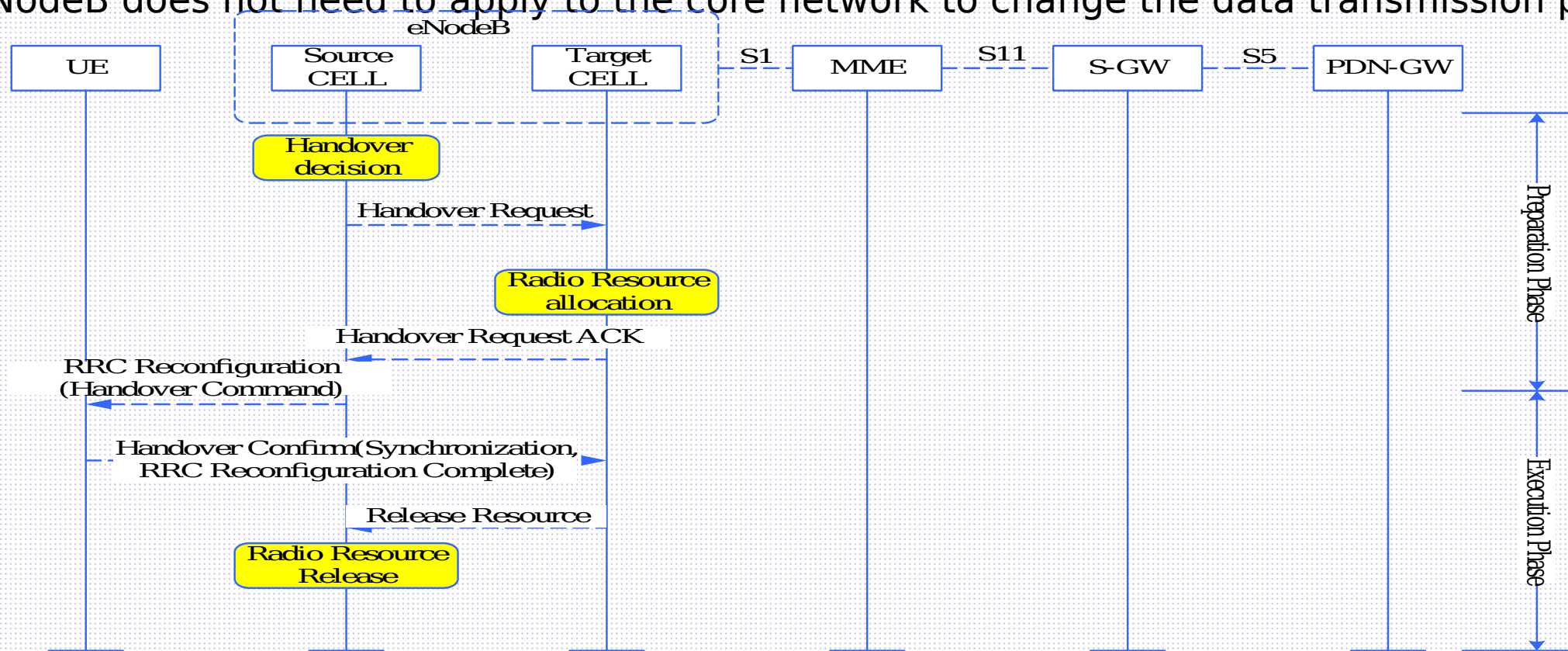
$Mn + Ofn + Ocn + Hys > Thres.$

-Event A4-triggered inter-frequency handover



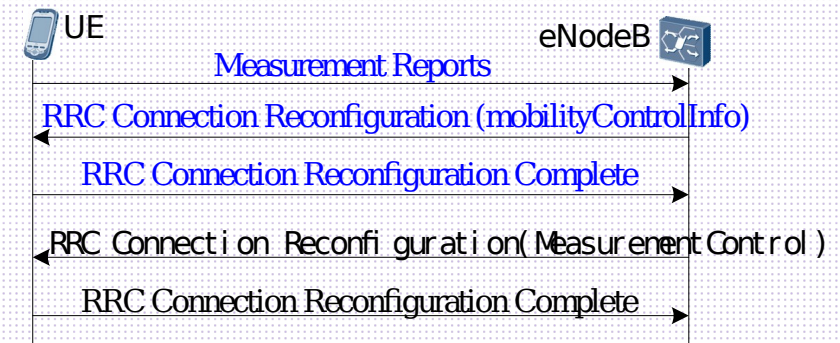
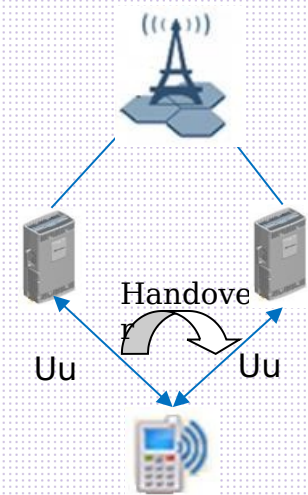
Intra-eNodeB inter-cell handover(1)

The intra-eNodeB cell handover procedure is simple. Because the handover source and target are in the same eNodeB, the eNodeB makes internal decisions. During intra-eNodeB handover, the handover preparation message is exchanged between boards in the eNodeB, and the eNodeB does not need to apply to the core network to change the data transmission path.

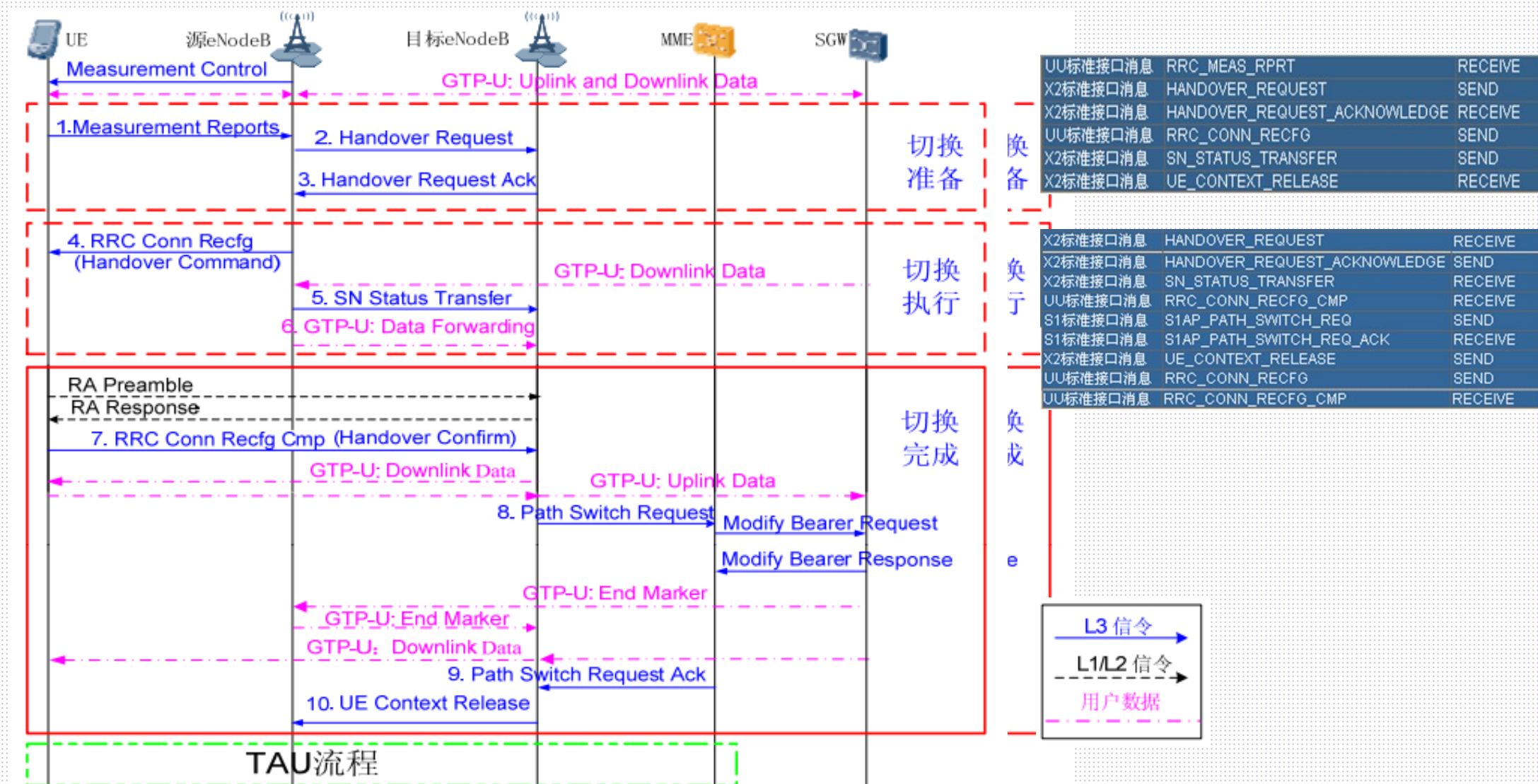


Intra-eNodeB inter-cell handover (2)

1. The UE reports an appropriate measurement report to trigger the eNodeB handover.
2. The eNodeB sends a handover command to the UE, requesting the UE to be handed over to a new cell. The message carries the following IEs ☐
 - The most important IE in the RRC reconfiguration message is MobilityControlInfo. If this IE exists in the message, the message is a handover command. ☐
3. After receiving this IE, the UE accesses the target cell based on the configuration carried in the message. After successful access, the UE sends a reconfiguration complete message to the target cell, indicating that the handover is successful.
4. After receiving the completion message of the new cell, the eNodeB re-delivers the measurement configuration to the UE according to the configuration of the new cell.



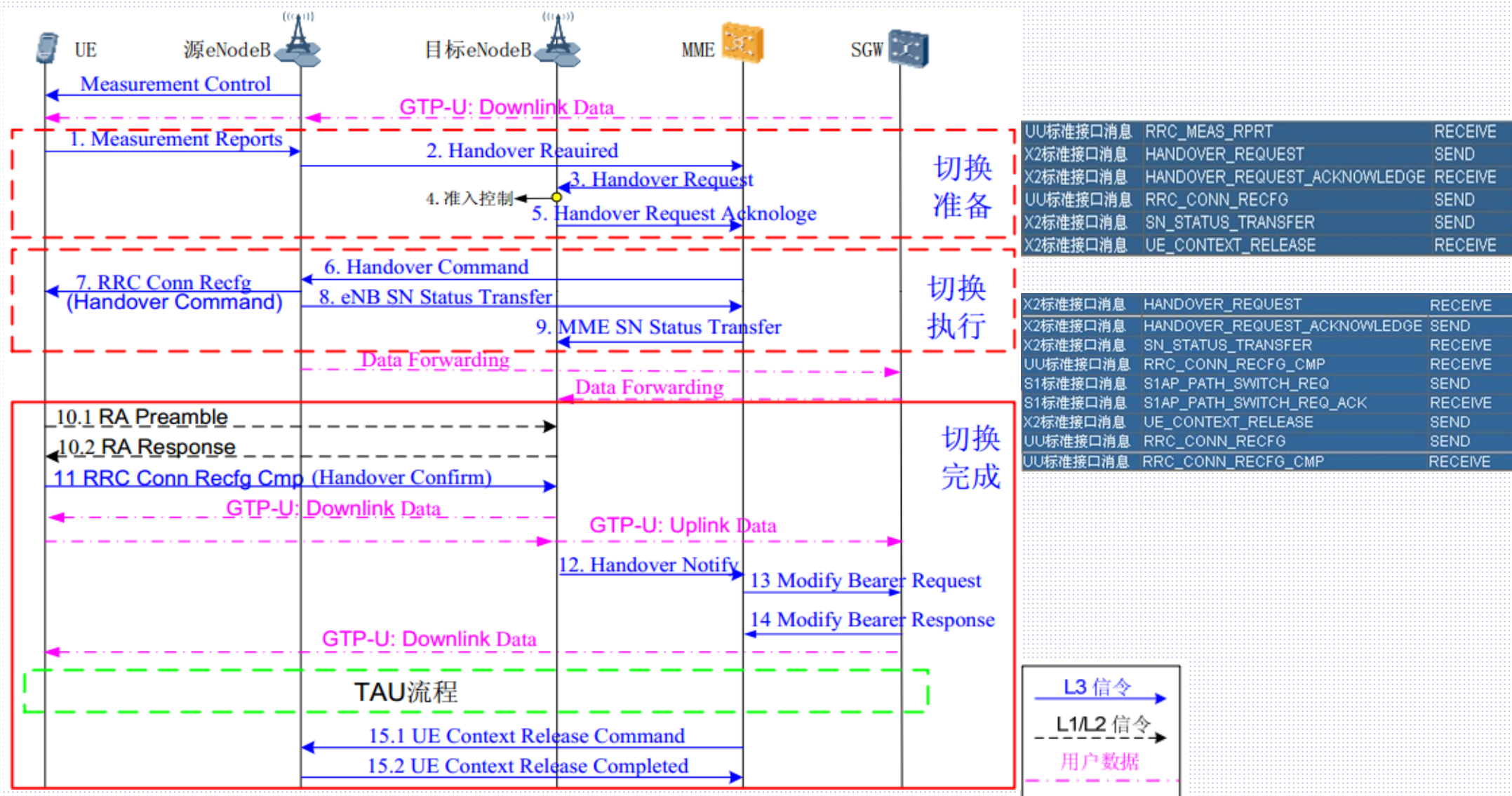
Inter-eNodeB X2-based handover procedure



Inter-eNodeB inter-cell handover

1. The UE sends an appropriate measurement report to trigger the eNodeB handover.
2. sending, by a source base station, a handover request to a target base station; and
3. After receiving the handover request message, the target eNodeB makes an admission decision. If the UE is allowed to be handed over, the target eNodeB sends a HANDOVER REQUESTACKNOWLEDGE message to the source eNodeB, indicating that the handover preparation is successful.
4. The source base station forwards the handover command to the UE.
5. If there is an E-RAB bearer to be forwarded, the source eNodeB starts the forwarding procedure and sends an SN Status Transfer message.
6. The UE is handed over to the target eNodeB by changing the radio parameter configuration according to the handover command.
7. After accessing a cell of the target base station, the UE sends a reconfiguration complete message to the target base station.
8. After receiving the completion message, the target eNodeB sends a PATH SWITCH REQUEST message to the core network to request the core network to switch the user plane path.
9. If the EPC allows the user-plane handover, it sends a PATH SWITCH REQUESTACKNOWLEDGE message to the target eNodeB.
10. After receiving the PATH SWITCH ACK message, the target eNodeB sends a UE CONTEXT RELEASE message to the

Inter-eNodeB S1-based handover procedure



Thank You

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